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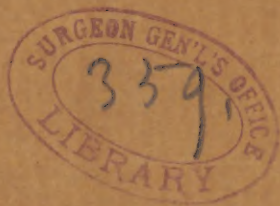
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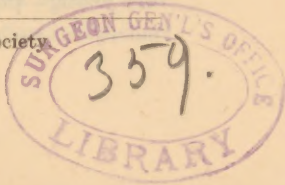
PREFERABLE METHODS OF FIXATION IN THE TREATMENT OF SIMPLE AND OF COMPOUND FRACTURES OF THE LEG.*

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How to treat successfully a simple fracture of the leg is a mechanical problem which may be solved in numberless ways. Reduction secured and fixation maintained, consolidation almost uniformly follows. No one plan of treatment is so much better than all others yet advanced as to be the one first thought of by a majority of surgeons anywhere. If I attempt to classify a number of the methods now in use, to contrast their relative merits and deficiencies and to collect for your inspection a quantity of apparatus, it will not be because I have anything original or even new to present. Some, at least, of the appliances to which I shall call your attention are not heard of in practice here. There are those present who have had vastly more experience than myself in the use of certain other of the technical resources of

*Read before the Toronto Medical Society



surgical art here presented, and from them I hope to elicit such a practical discussion as shall more than make up for the defects in my own presentation of the subject.

"Every surgeon," wrote Bell in 1815, "sets a broken limb as he writes his name, after a fashion of his own." We get our creeds in our cradles and our routine ways of immobilizing fractures from the offices and schools in which our student days are spent. Once in the rut it is easier to jog along than to make an effort to reach higher ground. Yet it is chiefly by the labors of those discontented ones, who are constantly striving to improve the means we have and to devise more perfect ones, that we make progress. The *unfittest* sometimes survives and the iconoclast is needed. To seek out and set in order the demerits of appliances which under the influence of certain great names have outlived their usefulness, is to do the surgical world a service which might rank equal with the services of those who have genius for construction rather than destruction.

I trust that both types are represented here to-night, and that the loose joints in this part of our surgical armour will be found and pierced, while at the same time we are strengthened by the free exchange of helpful suggestions. Young—that is very young—physicians are apt to have a special remedy for each disease or symptom, and to think

they should have a special splint for each fracture. With ripening experience the tendency is to lessen the number of drugs used and to recognize that the essentials for fracture treatment are few and simple. An ample outfit, one with which many of us could get along very comfortably, need contain nothing ponderable beside thin basswood, mill-board, batting, bandages, cheese-cloth and plaster-of-Paris. The imponderable essentials are anatomical knowledge, the training of the hand, and what I once heard Mr. Erichsen call, "surgical horse-sense."

From my point of view it hardly seems that profitable discussion can be had regarding a choice of methods in the treatment of the later stages of simple fractures of the leg. There does not appear to be room for much divergence of opinion. The complete-encasement of the limb by plaster-of-Paris bandages is admitted to be the procedure which gives to both patient and surgeon the greatest degree of security and comfort. So well known has this method become that I shall refer to but a few points regarding it. It has seemed to me worth while to have the crinoline or cheese-cloth, from which the bandages are made, boiled in a solution of washing-soda and then in clear water. This makes it an absorbent gauze ; it will sink at once if thrown into water, and plaster will set in its meshes as well as on its surface. Plaster

dressings made with it wear out like felt, instead of scaling off and cracking. If a web of cheese-cloth be rolled tightly on a wooden cylinder and this placed in a lathe, it can, as suggested by Martin, of Boston, be cut in a few moments into bandages of any desired width. The cutting is done by holding one corner of a broad chisel against the cylinder while it is in rapid motion. I have brought a roll so divided with me to show you; each section is fifty yards long by three inches wide. Cheese-cloth will not tear like thicker cotton, and life is too short to waste in cutting bandage material by hand. For crinoline, the bookbinder's knife has been suggested, and this machine will smoothly and rapidly divide the cloth into strips.

The earlier a plaster bandage is used the thicker should be, in my opinion, the layer of cotton under it. Batting makes the best padding while swelling exists and the patient is kept in bed. After all swelling has subsided and the patient is allowed to go around on crutches, padding by a single layer of old shrunk blanket has some advantages over that by batting or wadding. Abundant cotton padding allows the leg to telescope down into its case, while blanket padding will make the support more perfectly crustacean in type, and will correspondingly relieve the injured part of the skeleton from pressure when the

patient is allowed to be up and about. Over the padding I always apply a firm dry flannel or cotton roller. It distributes the pressure evenly and lessens the risk of undue constriction.

There is no analogy between a bandage so used and a "primary roller," that is, one used under splints, applied to a part only of the circumference of a limb. While so good a surgery as that by Agnew advises the primary roller, and we continue to meet with physicians who employ it, I feel justified in asking for an expression of opinion from those present regarding this dangerous relic of the dark ages. In applying the plaster bandage so as to cover in the heel, if each turn be carried over the instep, there will be such a thickening at this part that slight pressure from the hands of the assistant making extension, or a slight change in the angle at which the foot and leg are being held, will lead to the formation of a ridge on the inner surface to groove the tissue on which it presses. To avoid this it is better to go back and forth over the heel from one malleolus to the other, binding all down smoothly by two or three final turns carried over the instep. The more figures-of-eight we can put into a dressing of this kind the better will it be, and the more it is felted together and the air expelled from between its layers by rubbing with the hand the longer will it last. To strengthen it without increasing its bulk,

the plan of interweaving two or more of the tin strips first advised by Dr. Fluhner, is a good one. They should be cut from heavy tin plate, since common tin bends so easily as to be almost worthless. A single long strip crossing the sole and passing up to the knee on each side, gives the best support when the fracture is in the lower fourth of the limb. The strips should be perforated from each side and fixed to the limb by passing the bandage alternately over and under them.

Returning now to the treatment of the earlier stages of simple fracture of the leg, we find scope for endless differences of opinion and practice. What should the ideal dressing for a broken leg be and do? In answer to this question, permit me to quote from an address delivered by Dr. Gay, before the Massachusetts Medical Society: "It must be simple, comfortable, cheap, readily obtained, easily applied and removed, and must allow a frequent inspection of the limb without disturbing the patient. It must be applicable to all cases, capable of correcting any and all deformities and of retaining the fragments in their desired position for an indefinite length of time; not liable to produce abrasions or other mischief, and once properly adjusted it should require little attention during the progress of the case." Let us try by this standard some of the dressings in

use here and elsewhere and note how far they fall short of our ideal appliance.

The support given may be by splints which are rigid or plastic, single or multiple. They may be applied to one or to more than one aspect of the limb, or the encasement may be complete.

A Rigid Single Splint.—The form known as Dupuytren's is capable of meeting the indications in a small proportion of cases of Potts' fracture. I should limit its employment to those instances in which we have to deal with marked and persistent outward displacement of the foot and but little backward displacement. A chief object of its use being to draw outward the upper end of the lower fragment of the fibula, it passes my comprehension why Erichsen and Stephen Smith should figure its application with a bandage directly over the break. Hamilton and Druitt show it correctly. The wonder need not be great that students so often mis-apply this splint, when the teaching by illustration is in such marked contrast to the teaching in the text. The importance of keeping the lower bandage below the external malleolus, and of having the pad both firm and thick at a point just above the internal malleolus, are points long insisted upon but constantly needing to be emphasized.

Mr. Bryant figures and advises the application of a single straight wooden splint with foot-piece,

for fractures of either one of the bones of the leg. Excepting as a temporary expedient, to be replaced as soon as possible by a more comfortable and efficient dressing, I am unable to endorse this plan.

Under the direction of Dr. Levis, of Philadelphia, a series of perforated and plated copper splints have been prepared and are largely sold in the U.S. Those for the leg are the least satisfactory in the entire set ; they are posterior gutters which are apt to fit imperfectly in spite of moulding by the hands. My chief objections to them are, that they do not surround the limb sufficiently to maintain the apposition of fragments, and that they do not keep the foot at a fixed angle with the leg. I show you samples of the various sizes supplied. A series of lateral splints of the same material would be very much better, and could be moulded without difficulty.

Rigid Splints, in pairs. are usually applied laterally. Thin straight boards here seem to me inefficient means of support. They do not clasp the soft parts, and in spite of padding they are very apt to press hurtfully upon bony processes. The old and excellent plan of placing two thin boards at the opposite ends of a towel, rolling them in it toward the centre till a space is left between them corresponding to the width of the limb, placing the leg upon this web, stretched so as to form a

posterior support, bringing up the sides and securing them after building a bird's nest of padding around each bony prominence, can be commended for temporary use. Folded newspapers do well for padding such splints. The toes can be kept from pointing by a strip of bandage passed around the ball of the foot and pinned to the splints upon each side. With such an apparel a patient can often be moved home without the disaster of having his simple fracture converted, on the way, into a compound one. I should be sorry, however, to have one of my own legs, if fractured, left for even a week or two in such a crude and uncomfortable appliance. Once, in consultation, I saw a patient, who died from the effects of sloughing over one malleous, produced by pressure of just such a pair of splints.

American surgical writers, as a rule, do not approve of carved wooden splints, while a goodly number of English surgeons endorse the kind known as Cline's. In America, Pratt's or Day's splints replace the English Cline model. Samples of each form are here presented. I must confess to an early prejudice against these splints derived from association with my old and greatly respected teacher, Frank H. Hamilton. With a considerable assortment of these appliances to choose from and with no hesitation in cutting them in order to secure a fit, one may make them serve useful pur-

poses. On the other hand, if the physician thinks more of the splint than of the patient, he is better without the splint, or the patient is better without him. It must be admitted that a splint, even partly fitted, is better than straight board in the hands of a practitioner with whom the jack-knife is not an instrument of precision.

Rigid Posterior and Lateral Supports.—Under this head I mention fracture boxes and the iron splint used with lateral supports, and known in England as Arnold's or Neville's.

The common fracture box has always seemed to me to be a poor affair. When allowed to rest upon the bed it is especially objectionable. While it may be a safe and conservative practice to teach the average student to use it for the first week or ten days, until swelling has gone down, I should be sorry to have to use it very often myself.

In the old days, when the manufacture of pus, by compound fracture, was considered to be a laudable industry, the bran box had more uses than at present. Where its use is indicated I think it well to have at hand the most improved form.

The one I show you is more nearly like those figured in Wyeth's Surgery or in Stimson's work on Fractures, than any other, but seems to have some advantages over either of these. It was made from directions which I furnished, but for which I make no claim of originality. The idea of having

sides to let down in sections was suggested by John Neil, nearly forty years ago. The sliding floor by which the box may be adjusted to suit any length of leg is a real advantage. By means of Schede's adhesive plaster sling for the heel, the application of which I show you, the suffering of the patient from pressure upon this part of his limb can be relieved, and the risk of having that surgical disgrace, a bed sore over the *os calcis*, entirely obviated.

The iron back splint, with well fitted lateral supports, when suspended, is better than a box. It can be made by any blacksmith; should be $2\frac{1}{2}$ to $3\frac{1}{2}$ inches wide, provided with cross pieces by which it can be swung, cut out at a point opposite the heel, bent at right-angles for the foot, and at an angle of 160° for the knee, and should be of metal sufficiently strong to support the weight of the limb without bending.

This appliance meets the indications excellently well in the treatment of severe cases of fracture of both bones, with over-lapping and over-riding of the fragments. It is not as well known here as it deserves to be, and so I show you a sample.

Without a doubt the most important advance ever made in the treatment of simple fractures was the introduction of plastic material for splint making. As surgeons, we can well afford to toast the memory of that unknown benefactor of his

race, who first padded a broken limb with moss and plastered it with clay.

Of plastic splints now in use we may make two divisions. The first of these will include all those softened by heat, or otherwise, and moulded to a part upon which they become firm and unyielding. The second division will include materials liquid at the time of application but subsequently hardening.

Gutta-percha is supplied in sheet form for splint making. I utter no malicious slander when I say that it is not eternal. With rubber goods generally most of us find this out to our cost. It is no better than other plastic material in any respect, and not so good in some. It is non-porous, expensive and short-lived. On the other hand, it can be moulded so as to perfectly fit any part, and no force need be used in shaping it.

Sole-leather, being inexpensive and easily obtained, is a favorite material with many. It should be slowly and perfectly softened in cool water, with or without acetic acid, and can then be adapted to the inequalities of a part almost as perfectly as gutta percha. One who has time at his disposal, and who by practice has gained some skill in working with leather, can make capital side splints from it. If it be imperfectly softened, the attempt to make it fit down to the exact shape of a limb may be the cause of new injury at the seat

of fracture. Exceedingly bad splints are often the result of trying to economize time by using very hot water for the softening of leather.

Felt, and similar poro plastic material, is supplied in sheets and in blocked forms. The English make is thicker and stronger than the American, and for the leg at least, the models adopted are decidedly the best. Softened by slightly moist heat, they are easily moulded and give sufficient support. I show you samples from leading manufacturers. These materials soon become soft and useless if dipped into hot water whenever a change of shape is required.

Koeker's adaptable splint seems to be a good form of shellac-stiffened cloth. It is, as you see, rather light for use upon heavy limbs.

Wire gauze has long been in use for splints. Its most distinguished advocate at present is Professor Jarvis S. Wight, of Brooklyn. He has been kind enough to send me samples of the best gauze for surgical uses.

The lighter variety has $\frac{1}{4}$ inch meshes, is made of No. 20 iron wire, and is dipped into molten zinc, so that the wires are coated, and the points of intersection firmly soldered together. So made, the gauze is light, clean, cheap, strong and easily moulded to fit a part.

Mill-board is often referred to as though it is the same thing as, or is interchangeable with, paste

board or straw-board. It is really a great deal better than either, and is at once excellent for all its proper uses, easily obtained and cheap. It may be used as rigid as $\frac{1}{4}$ inch deal, or as plastic as felt or gutta-percha. I am in the habit of advising students to stuff a long stocking with oakum and to use it as a model in making plaster dressings and in moulding mill-board. In my hearing, many old practitioners have expressed surprise at the really excellent quality of the splints which were made by moistening the mill-board just sufficiently with hot water, moulding and bandaging it upon the model, and allowing it to dry in position. Additional strength and an elegant finish can be given to such splints by an outside coating of silicate of soda.

Practice of this kind wastes no time, since, so far as fractures are concerned, it helps to make us independent of the instrument maker.

In the second division, as starch dressings are practically obsolete, I shall consider only silicate of soda and plaster-of-Paris. The silicate I have used for a number of years. As it is not easily obtained here, and may not be familiar to all present, I place a sample before you. From it light, clean, strong and elegant splints can be made, but it is sticky to handle, and dries so slowly as not to give security against displacement by the time the physician is ready to leave the

patient. It has been charged with causing extensive sloughing when allowed to remain in contact with the skin.

My personal experience with plaster-of-Paris, in the treatment of leg fractures, includes a series of thirty-eight consecutive cases, put up as soon as reduced, in one or other of the forms of splint presently to be described. I have never completely encased the limb in plaster bandages during the first week of treatment. In no instance was it thought necessary to wait and see if swelling would come on or for it to subside, and no increase in its amount was ever noted after the dressing was applied. The amount of ensheathing callus thrown out in these cases was suprisingly less than that which I have seen in cases treated by other methods. My three first cases were treated by the regular Bavarian splint, made by pouring plaster mud between two layers of flannel secured together down the back of the leg. Becoming dissatisfied with the weight and clumsy look of this dressing, I substituted, as many others have done, layers of cloth soaked in plaster for the plaster alone. Later, the doubled piece of flannel was omitted and layers of gauze or blanketting, cut by the measure of the patient's stocking and bandaged to the sides of the limb somewhat after the manner suggested by Mr. John Croft, became the favorite method. Finally I adopted,

and have now used for four years, the plaster posterior splint, essentially, as it was perfected by



FIG. 1.

my friend, Dr. Kingman, and others in the Boston city hospital. No new principle is involved in

the making of this splint. It is not the posterior splint described by Esmarch or by MacCormac. It is not the same thing as a plaster bandage with an inch-wide strip removed down its centre line in front. It differs from, and is better than either of these for the early treatment of simple fractures. I show you samples and photographs of the completed splint, and will now demonstrate the method by which it is made. The materials required are, cotton-wadding, cheese-cloth and plaster of Paris. I have lately been substituting scrim, a coarse and strong fabric, for the cheese cloth as a less number of layers will give equal strength. I have this material here and also a splint made from it. The leg is to be bandaged with the batting, which, for the purpose, is torn into strips four inches wide and applied as a roller. Using the sound leg as a model, to save the injured one from movement, a pattern is cut which shall cover in all of the leg excepting a space an inch wide along its anterior aspect. Deep slashes opposite the heel allow the part for the sole of the foot to be brought into a right-angle with that for the leg without forming clumsy folds at the ankle. From this pattern four or five layers of scrim or from six to nine of cheese-cloth are cut. Then with extension made and the foot properly held, the strips are to be saturated with a cream made by sifting—not stirring—plaster into warm water,

smoothed one upon another, applied to the posterior aspect of the limb, interleaved by the slashes at

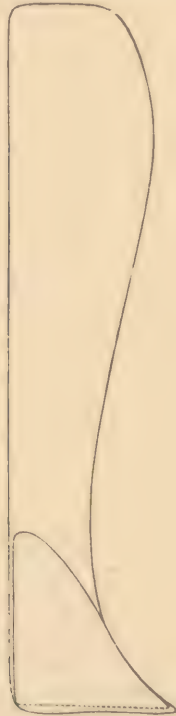


FIG. 2.

the ankle so as to hold the foot at right-angles with the leg, moulded to the part and then firmly

bandaged to it with a cotton roller. He who is to be responsible for the result had better, as soon as this bandage is on, hold the limb in proper position till the plaster sets. To resign the duty into unskilled hands may mean either a deformity or the necessity for a new splint.

No more skill and no better judgment is called for in the use of this method than is needed for successful treatment by any other. A little practice will make almost anyone familiar with its essential details, and the result of its use may often become, as I can testify, a subject for the mutual gratulation of surgeon and patient.

This then is the dressing which I present to your notice as being more nearly the ideal one than any other yet proposed. Permit me to quote again from Dr. Gay: "Properly applied, it is comfortable and efficient, it is self-retaining, it holds the fragments firmly in position, it allows the patient to be moved or to move himself without danger of disturbing the fracture, it permits the parts to be readily examined. Being opened throughout its entire length the bandage accommodates itself to the swelling of the limb without danger of strangulation, it can be applied immediately after the accident, there being no necessity for waiting until the inflammatory stage has subsided. It can be removed and re-adjusted with ease and can be worn indefinitely."

Any and every means by which displacement of the fragments is likely to be prevented, may pro

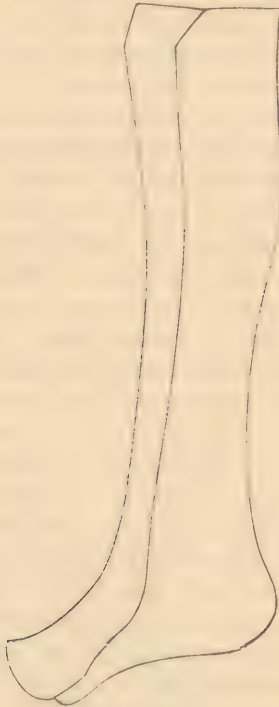


FIG. 3.

perly be considered in discussing fixation. Position, suspension, extension and tenotomy become in this

way possible factors in fixation. My own experience has been limited to the treatment of cases with the leg in the straight position, or at an angle of not more than 160° with the thigh. Reasoning from the ease with which reduction can at times be effected when the leg is flexed to a right-angle with the thigh, as well as from the comfort given the patient before his fracture is set, by flexing the injured limb to relax the calf muscles and allowing it to rest upon its outer side, I am disposed to think favorably of this position continued throughout the stage of consolidation in certain cases. I will leave it for those who have had experience in this matter, to define the cases which are suitable for such treatment. Theoretically, only fractures in the lower part of the leg should be put up with the knee unsecured.

Stanley Boyd, in his late and excellent revision of Druitt's Surgery, makes the curiously inaccurate statement, that in the United States fractures of the leg are usually treated by Buck's method—the American stirrup (meaning by these terms the weight and pulley extension), and that coaptation splints (Cline's) are also used when the fracture is oblique. It would be interesting to know in what small proportion of cases the members of this Society have used the weight and pulley for leg fractures, and in what still smaller proportion they succeeded in mak-

ing this form of extension honestly efficient in overcoming deformity. It has appeared to me to be so difficult to obtain a purchase on the parts below the fracture for our extending force, without running the risk of ligating the limb or making injurious pressure upon parts like the instep, unfitted to sustain it, that I have not even made trial of this expedient. And before doing so, I shall certainly make trial of one or other of the two forms of double inclined plane which are here presented—the Liston's splint improved by McIntyre, or the wooden apparatus manufactured by Pratt & Son, of Bennington, Vt. When displacement is prevented by keeping the limb at a certain fixed angle, these appliances may prove useful.

Suspension.—I have seldom seen a broken leg doing so well without suspension, that it would not do better with it. One need not pay \$20 or \$30 for a Salter's swing, when any ordinary blacksmith, if shown how, can for \$4 or \$5, make one equally good. I show you one which is easily taken apart for convenience of carrying. This I have had in use for nearly ten years, and it has paid for itself many times over.

A simpler and quite familiar frame is this, which resembles two small window sash hinged together along one side. Simplicity and portability can go even further than this, and I show you here a bar of wood, $1\frac{1}{2}$ inches square by 2 feet long. Into

the upper surface of this and near each end, a screw hook is fixed, by which it may be suspended over and parallel with the injured leg. Into its under surface three or four more screw hooks are fixed, and from them the leg is, by loops of bandage or otherwise, suspended. Dr. Walker, of Detroit, was the first, so far as I know, to describe the use of a bar like this. In practice, we often find that loops of bandage used for the suspension of limbs soon draw into ropes. Hamilton, to obviate this and to distribute the pressure along the limb, suggested the use of broad leather loops. As these are not always at hand, I have used instead starched linen cuffs, one cuff at the ankle and one below the knee, suspended by soft cord or bandage so as not to tear out the button-holes, will answer every purpose. In swinging a limb, it is good practice to have the knee slightly higher than the ankle. Motion at the point of fracture, muscular starting and pain from pressure on the heel, are almost if not entirely obviated by suspension, and yet I feel sure that no small number of limbs are kept lying upon the bed throughout the treatment.

The discussion of tenotomy of the tendo-achilles I leave to others, as I have had no practical experience with it. In very oblique fractures of the tibia, compound or threatening to become so, and in the V-shaped fractures first and best described by Gosselin, this procedure may well commend itself to our consideration.

Compound Fractures of the Leg. -- Antiseptic surgery has revolutionized the treatment of this class of injuries and reduced the mortality of cases not demanding amputation, from over 30 %, to practically no mortality at all. Volkmann, in 1876, startled the surgical world by reporting 75 consecutive recoveries. Dennis, in 1886, records 150 cases without a death due to septic causes. The very success we now attain brings to us new dangers. Men who formerly would have died now recover, and if not turned out models of manly symmetry, are very prone to listen to the suggestions of Ishmael and of Ananias, and to try and recover damages from those to whom they owe debts of gratitude for life prolonged. In selecting our methods of fixation for these cases, we should bear constantly in mind the fact that we may, within a few months, have to defend in the courts the procedures we adopt.

He who studies to be fertile in helpful resources will not be tied to any routine practice. After testing a considerable number of plans, such as fenestrated and bracketed plaster splints, the bran box, etc., I have settled upon one method as being the best under all ordinary circumstances. The plan referred to is to make an anterior and a posterior splint, each of eight or ten layers of cheesecloth and each extending from the toes to the mid-thigh. The anterior one only needs to be removed

for the renewal of the antiseptic dressing over the wound. MacCormac gives outlines of good patterns for these splints, and I present for your inspection a complete pair. The plaster posterior splint, described as best for simple fractures, I have used in but a single case of compound fracture. It gave satisfactory support, but not as free access to the wound as would have been required had the latter done badly from any cause.

In conclusion, permit me to submit the following propositions for your discussion :—

1. Plastic appliances are the best for the fixation of fractures of the leg in all their forms and at all stages of their treatment. Exception, certain cases of Potts' fracture.

2. For the early fixation of simple fractures, the plaster posterior splint is the best and safest appliance yet suggested.

3. Next to it should rank side splints made from plaster-soaked blanket, or open-meshed cotton, bandaged on so as to be hinged along the back.

4. In the later stages of all simple fractures of the leg, the complete encasement of the limb by plaster bandages is the preferable plan of treatment.

5. In treating compound fractures of the leg, posterior and anterior splints made of plaster-soaked gauze, are ordinarily the best for fixation.

Exceptionally fenestrated or bracketed plaster splints may meet the indications more perfectly. Without considerable practice in the use of plaster, the fracture box suspended may be safer, both for the patient at the time and for the surgeon subsequently.

· 259 Simcoe St.

